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sets firmly, apply this to the silver surface and allow it to harden. It should then be easy to remove the silver grating from the glass grating and the reproduction should have all the gloss and accuracy of the surface serving as the matrix. My interest in the matter was the possibility of easily and rapidly obtaining fairly good gratings without great expense, so that students in laboratories might use them without restraint. From one good glass grating numerous reproductions could be had at any time.

ELIHU THOMSON.

SWAMPSCOTT, MASS.,
Jan. 5, 1901.

THE FRICTIONAL EFFECT OF RAILWAY TRAINS ON THE AIR.

AN interesting and in some respects exceptionally important paper, read by Professor F. E. Nipher before the St. Louis Academy of Science has just been published by that Society in its transactions.* In this paper, the results of an experimental investigation of the effect of railway trains in the production of air-currents, and in causing the motion of adjacent bodies, are given with tabulated and diagrammed data. The effect of a rapidly moving express-train in producing strong air-currents is familiar to all who have seen anything of that kind of train-service, and the results of action of these fast-moving currents in overturning and in transporting objects near the track are hardly less familiar; but this is the first investigation conducted in a scientific and satisfactory manner to determine the quantitative measures of such effects. The stimulus to this particular research seems to have been the denial, by the Supreme Court of Missouri, that such effects are or can be produced.†

The station agents of all the great trunk-lines

* The Frictional Effect of Railway Trains upon the Air; Francis E. Nipher. *Trans. Acad. of Science of St. Louis*; Vol. X., No. 10. Issued Nov. 12, 1900.

† "When the case was tried a second time, and again resulted in a verdict against the company, the Supreme Court attacked the experts it had approved in the first reversal and threw out their uncontested evidence. * * * The Supreme Court of Missouri decides that the physical laws of the universe do not exist, so far as that august assemblage is concerned." —*St. Louis Mirror*, November 29, 1900.

of railway over which fast trains are operated are invariably cautioned regarding this danger and are careful to warn people against standing near the track when an express train passes. Small articles, and especially bulky and light merchandise, may often be seen to move under the 'suction' so produced, and, in the case referred to, a boy standing near the track, awaiting the passing of the coming fast train, and about to cross, was overthrown and rolled under the wheels and killed. The evidence showed that he was not struck by the train and the upper part of his body was not bruised. 'He fell after part of the train had passed.' The Court, however, repudiated the evidence of two scientific men of recognized attainments and distinction, testifying to the existence of known facts and to the probability of the claim of the plaintiffs in the case. The outcome of this doubt of the evidence was the employment by Mr. Nipher of a large part of the succeeding summer in the investigations here recorded, which were carried on, on the various roads leading out of St. Louis to Burlington, Chicago and Cairo. The Illinois Central Railroad finally fitted up a special car for the work; this was employed in securing the larger part of the information published.

The difference of pressure was taken between the interior of the car and some one point, selected by the observer, in making a series of observations from contact with the side of the car to a stratum several feet from the side, and the successive differences of pressure constitute measures of the varying tendency to carry along loose bodies near the track and of the tendency, also, to rotate them. A cup-shaped collector was used and the Newtonian equation was adopted. The coefficient, for pounds per square foot and miles per hour, was found to be 0.0025, very nearly, without wind. Still air is only reached at distances of sometimes many feet from the side of the train. The curve of varying pressures relatively to the car was found to be, as plotted, approximately hyperbolic, the vertical asymptote finding its position a short distance inside the car. The pressures measured range from 3.4 to 6 pounds on the square foot, at distances of 0 to 30 inches from the side of the car; the mean speed being 38 to 46, usually about 40, miles an hour; at which speed the

head-pressure relatively to the earth would be about four pounds per square foot. Light winds, sometimes following, sometimes resisting, the train, caused some variations which were allowed for in computations.

It is to be noted that a plane surface would have given a higher resistance, by at least 50 per cent., than was recorded by the cup-shaped vane.

R. H. T.

TRIVALENT CARBON.

IN the *Journal of the American Chemical Society* for November appeared an article of very unusual interest. By the action of silver, mercury or zinc on triphenylchloromethane Dr. M. Gomberg has obtained a new hydrocarbon, *triphenyl-methyl*, $(C_6H_5)_3C$. For some reason, perhaps because of space relations involved, two molecules of this hydrocarbon do not unite to form hexaphenylethane, $(C_6H_5)_3C-C(C_6H_5)_3$, as would be expected. The new body is the only one among the seventy thousand or more compounds of carbon, which contains an odd number of atoms of odd valence. The compound furnishes the first opportunity of studying the properties of a substance containing a carbon atom that is almost certainly trivalent. From this standpoint, as well as others, the discovery possesses a great theoretical interest. Especially the properties of triphenyl methyl in its rapid absorption of oxygen furnish a practically complete refutation of the view that benzene, ethylene and similar compounds contain trivalent carbon.

W. A. N.

COLUMBIA UNIVERSITY.

THE trustees of Columbia University have authorized the publication of the following statement drawn up by President Low:

The problem of Columbia University can now be defined, for the first time since, in 1892, it was determined to move to Morningside Heights.

Cost of land and development at Morningside Heights,	\$6,516,300 17
Improvements at College of Physicians and Surgeons,	879,688 43
	<hr/>
	\$7,395,988 60
Interest to June 30, 1900,	586,519 92
	<hr/>
	\$7,982,508 52

Of this large sum the University has succeeded in paying, mostly out of gifts and legacies, \$4,250,000. Of its outstanding debt the sum of \$750,000 is provided for. It still owes \$3,000,000 that is not provided for; upon which the annual interest payable is \$98,500.

Careful computations justify the undersigned in saying that eight years from now the University will be able, by the increase of income from its fees and endowments to care for its floating debt without embarrassment to its educational work. The falling-in of contingent interests already definitely established may hasten this result importantly. Experience also demonstrates that the endowments of the University are likely to be constantly increased by gift and legacy year by year.

The problem of the University, therefore, is to conduct its educational work for a period of eight years without curtailment by reason of the interest to be paid in the meanwhile on its outstanding debt, say \$100,000 a year.

For the academic year ending June 30, 1897, the last year at the 49th street site, the University had a deficiency on its current educational account, disregarding interest, of \$48,260. For the coming academic year, 1901-1902, the estimates for the Budget already made show that the ordinary income of the University next year will pay all of its current expenses except the interest on its outstanding debt.

If our interest payable can be taken care of for eight years, the problem of the University growing out of its removal to the new site will be solved.

From the purely business point of view, the operations of the University have been already justified. Its plant has been increased in value, after deducting the proceeds of its old buildings, by more than \$6,250,000, taking its new site at cost. If the new site be taken at its present market value, the increase in the value of the University's plant would be not less than \$8,000,000. The debt incurred in producing these results, still remaining unprovided for, is only \$3,000,000. In addition, University Hall is now being enlarged by gift; and Earl Hall is about to be erected, also by gift. In the same interval, the trust funds of the University have been increased by \$1,250,-